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Impact on the Rankings of Mutual Funds Due to Choice of Performance Measure: An Asian Perspective

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Abstract

Existing literature on performance evaluation has used wide variety of performance measures to estimate the risk-return benefits of a portfolio. This has raised questions about the reliability and accuracy of the performance measures. Investors are also concerned whether the choice of a performance measure has an impact on their investment decisions. This paper attempts to resolve this issue by comparing eight risk-adjusted and downside risk-adjusted performance measures using a sample of open-ended equity mutual funds of India, Singapore and Taiwan. We estimate the performance measures by creating a moving window of time and perform Spearman's rank correlation on them. Results show that performance measures that fall in the same category, for example Value-at-Risk (VaR) based measures, are highly correlated to each other, but as we go further and use performance measures that are different from each other, rank correlations decrease. In our study, rank correlations for Sortino ratio are significantly lower for Singapore and Taiwan markets. Therefore, we conclude that the choice of performance measure is significant as it affects the rankings of mutual funds.

Keywords: Mutual Funds, Performance Evaluation, Rank Correlation, Risk-Adjusted Performance Measures, Downside Risk-Adjusted Performance Measures

JEL Classification Codes: D81; G10; G11

1. Introduction

In the early days, mutual funds were not the first investment choice of an investor, as very little importance was given on creating investor awareness. Investments were mainly focused towards other avenues such as bank deposits, securities, real estate, and gold. Mutual funds gained importance in the 1990s and are one of the most preferred investment alternatives today. Mutual funds are investment vehicles that pool in money from retail and institutional investors and invest the pooled funds in

various instruments such as stocks, bonds and money market instruments. They are managed by portfolio or fund managers, employed by mutual fund companies also called as asset management companies. Most mutual funds are open-ended in nature. This signifies that investors are permitted to withdraw their investment at the market price on the day of withdrawal. Mutual funds can be classified in to equity funds, bond funds, money market funds, exchange traded funds and hybrid funds.

Investors invest in mutual funds in order to earn good returns for a low level of risk. It is their responsibility to decide whether to invest in a specific mutual fund or not, but they rely on the skills and expertise of the fund managers to help them to meet their investment objectives. An investor looks at different factors, such as his risk appetite, return expectation, portfolio composition, fund performance, funds rankings and load structure to name a few, before taking an investment decision. The two factors that are commonly used by average investors to help them with decision-making are fund performance and rankings. We focus on these two factors in our study.

To measure mutual fund performance, many performance ratios have developed over the years. Portfolio theory introduced by Markowitz (1959) helped to identify the need for estimating portfolio performance. Consequently, several performance measures were introduced for evaluating mutual fund performance. These measures, such as Jensen's Alpha, Fama and French (1993) three-factor model, Sharpe ratio and Treynor ratio, are categorized as risk-adjusted performance measures. These measures focus only on the mutual funds' risk-return relationship, but in reality, most investors are risk-averse. Such investors are interested in identifying the potential of loss of their investments. As a result, downside risk-adjusted performance measures evolved. Some of the new set of performance ratios used in our study are Sortino ratio, excess return on VaR, conditional Sharpe ratio and modified Sharpe ratio. These measures focus on the downside risk of a mutual fund.

Now, as new performance measures are introduced, their accuracy and reliability is questioned. This also creates confusion among investors to decide which measure is appropriate for performance measurement. Existing literatures on performance measurement encourage the determination of correlation among these measures to see if they have any impact on the funds rankings, for example Eling and Schuhmacher (2007). They compare Sharpe ratio with 12 other performance measures to find very high rank correlation between them. When the performance measures are highly correlated, they do not have any impact on the rankings of mutual funds, therefore they conclude that the choice of performance measure is irrelevant. Eling (2008) and Razafitombo (2010) also support this outcome, but it is challenged by Ornelas, Silva Júnior and Fernandes (2012) and Zakamouline (2010) who contradict this thought and argue that each performance measure uses a different approach to measure performance. Therefore, it is very important to choose a performance measure as the choice can have a significant impact on investors' investment decision. Ornelas, Silva Júnior and Fernandes (2012) and Zakamouline (2010) demonstrate that the choice of performance measure plays an important role in performance evaluation. Zakamouline (2010) uses the same hedge fund database used by Eling and Schuhmacher (2007) to find that rankings may differ for some performance measures. The reasons for this difference is explained by Zakamouline (2010) as follows: a) Different performance measures may result in different rankings, but since Eling and Schuhmacher (2007) use only few measures, from more than a hundred reviewed by Cogneau and Hübner (2009), they observe similar rank correlations between performance measures. For example, Zakamouline (2010) finds in his study that Rachev ratio and Farinelli-Tibiletti¹ ratio can result in low rank correlations. b) Eling and Schuhmacher (2007) estimate rankings only on the basis of Spearman's rank correlation coefficient, other correlation models may result in differences in rankings. c) They also find that rankings are similar when return distributions are close to normal. Hedge fund returns used by Eling and Schuhmacher (2007) are normally distributed, thus making it difficult to find differences in rankings, whereas the dataset used by Zakamouline (2010) is not normally distributed resulting in a different outcome.

Due to this conflicting view among academic researchers, we can question the application of different performance measures that do not cause any impact on funds' rankings. To find an answer to

¹ See Zakamouline (2010) for detailed information on these ratios.

this question, we compute the rankings of open-ended equity mutual funds of India, Singapore, and Taiwan with an aim identify whether mutual funds rankings are affected by the choice of a performance measure. We study the rankings of risk-adjusted measures such as Jensen's Alpha, Fama and French (1993) three-factor model, Sharpe ratio and Treynor ratio; and downside risk-adjusted measures such as Sortino ratio, excess return on VaR, conditional Sharpe ratio and modified Sharpe ratio. The motivation of this study arises from the debate of choosing a performance measure to assess mutual fund performance. Even though Eling and Schuhmacher (2007) and many others conclude that the choice of performance measure is not significant, disarray among academics and practitioners still exist. In this context, it becomes relevant to study the performance measures and determine whether the choice of performance measure affects the ranking of mutual funds.

The remainder of the paper is organized as follows. In chapter 2, we discuss about the existing literature on performance measures used in theory and practice. We also review recent studies that will help us to find out whether the ranking of mutual funds is altered due to the preference of a performance measure. In chapter 3, we discuss about the risk-adjusted and downside risk-adjusted performance measures that we use for determining whether the evaluation of mutual funds is affected by the choice of performance measure. We also present our dataset and results of our analysis in this section. Finally, chapter 4 provides a summary of the study.

2. Theoretical and Empirical Evidence

In this section, we provide a review of literature on various risk-adjusted and downside risk-adjusted measures used for evaluating the rankings and performance of mutual funds. This literature review is important for understanding the theoretical and empirical studies that have employed several performance measures to identify their impact on the performance of mutual funds. Based on these theoretical and empirical literatures we test the performance of mutual funds of India, Singapore and Taiwan to determine whether the application of different performance measures affects the rankings of mutual funds. The following is the brief review of literature.

2.1. History and Development of Performance Measures

The foundation of portfolio performance was laid down in the portfolio theory introduced by Markowitz (1959). In his study, he attempts to define an appropriate portfolio for large investors. He explains that a portfolio must comprise of assets that meets the objectives of the investors. Investors aim to either achieve higher returns or minimize their portfolio risk. Analyzing the portfolio will help in determining whether investor's objectives are met, thus resolving the portfolio selection problem. Markowitz's ideas on portfolio selection led to research on equilibrium theory of asset pricing and relationship between price of an asset and its risk factors. This contributed to the development of the Capital Asset Pricing Model (CAPM) through the independent works of Treynor (1962)², Sharpe (1964), Lintner (1965) and Mossin (1966). CAPM defines the expected rate of return of an asset for a given level of non-diversified risk, also called as beta. It establishes a linear relationship between expected asset returns and beta with zero intercept. Due to the practical significance of this risk-return relationship, it is tested in many studies (MacKinlay 1995). Jensen (1968) argues that asset-pricing measures do not test the ability of the asset to outperform the market over a long-term period. He, therefore, introduces Jensen's Alpha to estimate portfolio performance by testing the forecasting ability of a fund manager to earn superior returns or reduce the riskiness of a portfolio. His multi-period version of CAPM contains alpha, which measures whether a fund earns positive or negative abnormal returns as compared to its benchmark. The model also uses a single factor that is beta to measure portfolio performance, which is criticized in literature because it can result in biased estimates of mutual fund performance (Bauer, Derwall and Otten 2007).

² Treynor (1962) is the unpublished work of Treynor, which signifies that the first CAPM was developed by him. Since his research remained unpublished and private, it is not cited much by current researchers (French 2003).

Considering the linear relationship between expected returns and beta, many studies bring in additional risk factors to review the zero-intercept hypothesis. Fama and French (1993) extend Jensen's Alpha to develop a three-factor model that considers market capitalization (size) and book-to-market ratio, in addition to beta, in measuring cross-sectional returns. Beta, when used alone or in connection to other variables, does not give much information about average returns, whereas, the same is not true for the remaining two variables. They also find that the intercept of portfolios comprising of these risk factors is closer to zero, which indicates these additional risk factors that were left out in CAPM are the root cause of deviations from zero-intercept (MacKinlay 1995). Although, this argument suggests that the multi-factor model improves performance evaluation by taking into account a number of additional risk factors, it is quite cumbersome to put it in practice because it requires many input variables (Eling 2008). Over the years, simpler models have been proposed to measure the risk-return relationship between assets. A paper concerning a practical method for establishing a better risk-return agreement was proposed by Roy (1952). He mentions that investors prefer taking reasonable safety measures to reduce the probability of loss. Investors want to safeguard their capital, which can be done effectively by setting a minimum level of acceptable return. He proposes the reward-to-variability ratio that allows investors to choose a portfolio with the lowest risk level, given the expected return and standard deviation. This ratio was proved useful for measuring mutual fund performance by Sharpe (1966), which was later known as the Sharpe ratio (Nawrocki 1999). Sharpe ratio measures the association between the returns earned by an investor for each unit of total risk. It does not distinguish between good and bad volatility, and therefore can be used to measure performance of a well-diversified portfolio representing total investment of an investor (Sortino and Price 1994). It is used to measure performance when returns are normally distributed. Similar to Sharpe ratio, Treynor ratio is also commonly used to measure portfolio performance for normally distributed returns. Treynor ratio was first introduced in 1965 to measure the relationship between portfolio returns in excess of risk-free rate of return and beta. Unlike Sharpe ratio, it does not consider total risk and therefore may not be suitable for measuring performance of a well-diversified portfolio. Both these measures are severely criticized in literature because they are appropriate to a normal return distribution, whereas mutual funds are more likely to generate abnormal return distribution (Eling 2008).

Due to this issue, many new models have developed to analyze returns that do not follow a normal distribution. For example, in order to make use of Sharpe ratio for a non-normal return distribution, Mahdavi (2004) demonstrates a new approach of estimating mutual fund performance referred as the Adjusted Sharpe ratio. This new method converts the return distribution of the portfolio to match the benchmark's distribution after considering the cost of conversion. The findings suggest that there is minimal difference between the results of Adjusted Sharpe ratio and Sharpe ratio, which may be due to minimal deviations from normality. Therefore, we can conclude that the application of Sharpe ratio should not be disregarded irrespective of the shape of the return distribution. Another measure, that is similar to Sharpe ratio, is the downside risk-adjusted measure called Sortino ratio. The foundation of downside risk-adjusted measures was laid down by Roy (1952). His concept of safeguarding the principal in times of risk was considered during the development of downside risk-adjusted measures. Sortino ratio was introduced by Sortino and Price (1994). It is a modification of the Sharpe ratio, but unlike Sharpe ratio, it does not use standard deviation to measure the dispersion on either side of the mean. The reason being, standard deviation does not differentiate between good and bad deviations. Roy suggests that if a minimum level of acceptable return for a portfolio is defined then the principal amount can be protected. Any return earned above the minimum acceptable return is favorable, and any return earned below the minimum acceptable return is unfavorable. Since, only unfavorable outcomes are related to risk and returns earned below minimum acceptable return are the only ones associated with risk. Therefore, Sortino and Price (1994) suggests that downside risk-adjusted measures that deal with returns earned below a minimum acceptable return should be used to get a true picture of the fund's performance. These negative deviations are measured by lower partial

moments³ (LPMs). Other downside risk-adjusted measures based on Roy's concept are Omega ratio, Kappa 3, upside potential ratio, Calmer ratio, Sterling ratio and Burke ratio. These ratios are similar to Sortino ratio which is based on the risk-taking capacity of an investor. Eling and Schuhmacher (2007) use these ratios in their study along with Sharpe ratio to estimate the correlations among them. These ratios belong to the same category of downside risk-adjusted measures, having similar characteristics, which may be the reason for similar rankings (Ornelas, Silva Júnior and Fernandes 2012).

The other set of downside risk-adjusted performance measures are based on Value-at-Risk (VaR). These measures are similar to Sharpe ratio, but use standard VaR or its modifications as a risk measure to estimate mutual fund performance. Excess Return on VaR, is a downside risk-adjusted measure that uses standard VaR in its denominator. It is expressed as a ratio of risk-premium to standard VaR (Eling and Schuhmacher 2007). Standard VaR estimates the potential loss over a specific time horizon for a given probability. It is a forward-looking measure but it is critiqued for being ignorant about the extreme loss a portfolio could incur in the left tail of the distribution (Kidd 2012). For this reason, an alternative measure called the conditional VaR (CVaR) was introduced (Rockafellar and Uryasev 2002). Conditional VaR measures the loss of a portfolio, which is beyond the scope of standard VaR. It concentrates on the frequency as well as the size of loss in case of extreme situations, unlike VaR which focuses only on frequency. Conditional Sharpe ratio uses CVaR as a ratio of risk premium to CVaR to measure portfolio performance. These two measures are appropriate when returns follow normal distribution. Therefore, when returns do not follow normal distribution, standard VaR and CVaR are not efficient. To tackle the issue of non-normal distribution, modified VaR (MVaR) was introduced by Favre and Galeano (2002). This measure is based on the Cornish-Fisher expansion⁴ to estimate VaR in the left tail of the distribution. They observe that the accuracy of standard VaR is substantially improved by MVaR because takes in to account investor's preferences for higher moments, such as skewness and kurtosis, of the return distribution. The downside risk-adjusted measure defined using MVaR is the modified Sharpe ratio. It is expressed as a ratio of risk premium to MVaR of a portfolio of non-normal return distributions (Eling and Schuhmacher 2007).

Over the years, many new performance measures have been introduced in literature. Although these measures are examined carefully, they are not as commonly practiced as Sharpe and Treynor ratios are used in the investment industry. The traditional single-factor and multi-factor models are also not much popular among practitioners because they have higher data requirements and are difficult to understand. On the other hand, Sharpe and Treynor ratios are very easy to compute and understand, and they have fewer data requirements as they do not calculate higher moments of return distribution (Eling 2008). We believe that in spite of the popularity of Sharpe and Treynor ratios, other measures discussed above also play a significant role in performance evaluation due to difference in their approach of computing risk. Availability of such a wide variety of performance measure makes it difficult to choose a best-suited measure for evaluating mutual fund performance. Therefore, in the next sub-section, we highlight a few recent studies that have used these measures to estimate fund performance. This discussion will help us to determine whether the rankings of mutual funds are affected by the selection of a performance measure.

2.2. Recent Studies on Performance Measurement

Determining a best-fit measure for evaluating the performance of mutual funds is crucial to our study. We focus on mutual funds as an asset class and the performance measures discussed in the previous sub-section for estimating the performance of mutual funds. Different risk-adjusted and downside risk-adjusted measures have developed over the years making it a complicated choice. Therefore, it becomes important to determine whether the choice of performance measure plays a significant role in the area of performance evaluation.

³ See Nawrocki (1999) for detailed information on the birth of lower partial moments (LPM).

⁴ The Cornish-Fisher expansion is a by-product of Cornish and Fisher (1938).

Many studies have analyzed performance measures from this viewpoint to arrive at contrasting conclusions. Few studies show that the choice of performance measure is insignificant. For example, different risk-adjusted performance measures are compared by Pedersen and Rudholm-Alfvin (2003) using several asset classes over the period 1998-2003 to find high rank correlation between the measures. Similarly, Pfingsten, Wagner and Wolferink (2004) find identical rankings for different performance measures using Spearman's rank correlation coefficient. Another study by Eling and Schuhmacher (2007) conducts a comparative analysis among Sharpe ratio and 12 other performance measures on a dataset of 2763 hedge funds. They compare the coefficients of Spearman's rank correlation to discover that all measures exhibit high rank correlations with respect to Sharpe ratio, where returns follow a normal distribution. Since, the results are insignificant, it suggests that rankings of hedge funds are not affected by the choice of performance measure. Thus, they conclude that any measure can be used for evaluating the performance of hedge funds.

We have seen that the studies discussed above make a comparison among performance measures, including measures based on the mean-variance framework. A limitation of these measures is that it assumes that fund returns are normally distributed. Conversely, if returns do not follow a normal distribution this approach is questionable. To determine whether this argument holds true, Adcock et al. (2010) study the impact of using downside risk-adjusted performance measures to a negatively skewed dataset. The correlation coefficients of Sharpe ratio, Sortino ratio, excess return on Value-at-Risk and excess return on Expected Shortfall are measured using Pearson's correlation, Spearman's rank correlation, Kendall's Tau and Cohen's Kappa. Though this analysis results in a favorable association between Sharpe ratio and other measures, analysis of another sample portfolio with higher variance in skewness and kurtosis shows that the performance of investment portfolios is impacted by the choice of performance measure. Another study by Zakamouline (2010) strongly contradicts the outcome of Eling and Schuhmacher (2007). It gives a new dimension to this discussion as the author finds that the choice of performance measure is very important to the evaluation of mutual fund performance. There are two reasons for supporting this argument, first, we are aware that not all performance measures estimate risk in a similar manner and second, hedge fund returns are not normally distributed, see Agarwal and Naik (2004) and Malkiel and Saha (2005). The author identifies the following for the results arrived upon by Eling and Schuhmacher (2007). For example, Eling and Schuhmacher (2007) base their study on a small set of performance measures from more than a hundred discussed in literature, see Cogneau and Hübner (2009). Therefore, one can suspect the correctness of the outcome of Eling and Schuhmacher (2007). The other measures that have not been used by them can produce distinct observations. Nearly 60% of their return distributions are normally distributed, which makes it difficult to identify differences in rankings. On these grounds we can consider that the results computed by Eling and Schuhmacher (2007) may not be correct. To prove this, Zakamouline (2010) performs a simulation analysis, which shows that some performance measures exhibit low rank correlations in relation to Sharpe ratio. A detailed analysis reflects that in spite of high rank correlations among the other measures, they do not display rankings that are identical to Sharpe ratio, thus, concluding that the choice of performance measure does affect the ranking of hedge funds. Research on determining the role of choice of performance measure on fund's rankings is carried further by Ornelas, Silva Júnior and Fernandes (2012). They use US mutual funds as their dataset to compare 13 different performance measures with Sharpe ratio. Their findings suggest that performance measures that fall in the same category defined by their characteristics demonstrate high rank correlations, whereas measures that fall in different categories show a decline in rank correlations among them. Since the performance measures used by Eling (2008) in their comparison are similar to each other, they result in identical rankings. The outcome of Ornelas, Silva Júnior and Fernandes (2012) contradicts Eling (2008) as the performance measures do not show extremely high correlation to each other and with Sharpe ratio.

Study by Eling and Schuhmacher (2007) concludes that the choice of performance measure does not matter, but theoretically it should matter because every measure views risk differently. Zakamouline (2010) and Ornelas, Silva Júnior and Fernandes (2012) agree with this opinion and

establish that performance measures do not result in similar rankings, therefore the choice of performance measure does affect performance evaluation. If performance measures of similar characteristics are employed or if majority of the data set is normally distributed, it might be difficult to identify differences in rankings. Therefore, we revisit some of the performance measures used by Eling and Schuhmacher (2007) along with single-factor and three-factor models to determine the impact on rankings of mutual funds. The next chapter discusses in detail about the performance measures employed, data set used and outcome of our analysis.

3. Mutual Fund Performance Measures, Data and Empirical Results

Portfolio performance is extensively discussed in finance. There are two ways to measure portfolio performance, measuring the skill of a fund manager to earn superior returns and the ability to reduce risk of a portfolio. Performance measurement may seem difficult without understanding the risk factors. As most investors are risk-averse, it appears appropriate to measure the effect of differential degrees of risk on the returns of a portfolio (Jensen 1968). This chapter measures the risk-return relationship of mutual funds using risk-adjusted and downside risk-adjusted performance measures discussed below. We then proceed with data collection and discuss the results of our empirical analysis in following section.

3.1. Risk-Adjusted Performance Measures

3.1.1. Jensen's Alpha

Jensen's Alpha was developed by Jensen (1968) from the early works of Treynor (1962), Sharpe (1964), Lintner (1965), and Mossin (1966) on the Capital Asset Pricing Model⁵. It is an improvement over CAPM as it incorporates multiple periods to determine funds returns over a long period. Jensen (1968) focused on the predictive ability of the fund managers to the returns of a fund, which helped to establish a relationship between asset pricing and performance evaluation. The measure is written as,

$$R_{pt} - R_{Ft} = \alpha_p + \beta_p [R_{Mt} - R_{Ft}] + \varepsilon_{pt} \quad (1)$$

Where, R_{pt} is return of portfolio p in time t , R_{Ft} is risk-free interest rate in time t , $\beta_p = \frac{\text{cov}(R_p, R_M)}{\sigma^2 R_M}$ is the systematic (market) risk, α_p is fund's abnormal return or Jensen's Alpha and ε_{pt} is error term in the regression. A positive alpha indicates that the fund has performed better than its benchmark; whereas a negative alpha says that the portfolio's performance is lower than its benchmark. This measure is widely used because it is strongly supported by CAPM. It is also easy to compute and interpret the results, and since it is a regression-based model, it gives both economic and statistic meaning to performance evaluation.

3.1.2. Fama and French Three-Factor Model

This model is used for examining the variation in mutual fund returns due to the additional risk factors, size and book-to-equity, introduced by Fama and French (1993). The model is given as,

$$R_{pt} - R_{Ft} = \alpha_p + \beta_p (R_{Mt} - R_{Ft}) + \beta_{pSMB} SMB_t + \beta_{pHML} HML_t + \varepsilon_{pt} \quad (2)$$

Where, β_p , β_{pSMB} and β_{pHML} are returns on a market portfolio p , returns on SMB (small minus big) portfolio and returns on HML (high minus low) portfolio respectively. SMB_t is the difference between return of a small-cap portfolio and a large cap portfolio at time t . It measures the "size risk". It reflects additional returns earned by investing in funds with relatively low market capitalization. This

⁵ CAPM is expressed as, $E(R_p) = R_F + \beta_p [E(R_M) - R_F]$

Where, $E(R_p)$ is expected return on portfolio p , R_F is risk-free interest rate, $\beta_p = \frac{\text{cov}(R_p, R_M)}{\sigma^2 R_M}$ is systematic risk and

$E(R_M)$ is expected return on market portfolio.

factor is sensitive to a large number of risk factors because it is relatively undiversified and has a reduced potential to imbibe the negativity of financial events. HML_t is the difference between returns of funds with high book-to-market ratio and low book-to-market ratio. It measures higher risk exposure for "value" funds versus "growth" funds. It measures additional returns earned by investing in high book-to-market value funds. The significance of this model is that it enables investors to identify the level of exposure to each risk factor by allowing them to weigh their portfolios. This helps them to target different levels of expected return (Marinelli 2010).

3.1.3. Sharpe Ratio

Sharpe ratio measures the difference between portfolio return and risk-free rate, called the risk premium, and compares it to total portfolio risk appraised by its standard deviation. For daily historical returns of mutual funds of India, Singapore and Taiwan, Sharpe ratio can be estimated as,

$$S_p = \frac{E(R_p) - R_F}{\sigma(R_p)} \quad (3)$$

Where, $E(R_p)$ is expected returns of portfolio p , R_F is risk-free rate of return and $\sigma(R_p)$ is standard deviation of portfolio returns. A number closer to one represents good portfolio performance, whereas under-performance is represented by a negative Sharpe ratio.

Identifying a risk measure that is suitable for measuring portfolio performance depends on the type of portfolio chosen by an investor. For example, for a well-diversified portfolio, the use of beta is acceptable, but for a portfolio consisting of only a few assets, application of total risk is appropriate (Sourd 2007). This phenomenon is explained by Eling and Schuhmacher (2007). Sharpe ratio is widely used for investment analysis by fund managers and investors. The reason being, it is easy to compute and it gives a quick summary of risk and return for the fund managers and investors' interpretation (Eling 2008).

3.1.4. Treynor Ratio

Treynor ratio is similar to Sharpe ratio. The only difference is that it measures portfolio performance as a ratio of risk premium to beta and not total risk. It is given as follows,

$$T_p = \frac{E(R_p) - R_F}{\beta} \quad (4)$$

Where, $E(R_p)$ is expected returns of portfolio p , R_F is risk-free rate of return and β_p is beta of the portfolio p which measures the systematic risk of the portfolio that is associated with the market and is not diversifiable. A higher ratio identifies higher return per unit of systematic risk. The advantage of using Treynor ratio is that it determines the performance of a fund with respect to the market, assuming that the fund manager has taken in to account the diversifiable risk, leaving behind only systematic risk. This limits the use of Treynor ratio for comparing well-diversified portfolios (Sourd 2007).

3.2. Downside Risk-Adjusted Performance Measures

3.2.1. Sortino Ratio

Sortino ratio is also similar to Sharpe ratio but it concentrates only on the downside risk factor. Downside deviations are measured by lower partial moments (LPMs) which analyzes the moment of degree n below the minimum acceptable return τ . Sortino ratio is expressed as a ratio of difference between portfolio return and minimum acceptable return divided by the LPM⁶ of order 2.

⁶ LPM of order n for portfolio p is given as, $LPM_{np}(\tau) = \frac{1}{T} \sum_{t=1}^T \max[\tau - r_{pt}, 0]^n$ (Eling and Schuhmacher 2007).

$$\text{Sortino Ratio} = \frac{r_p^d - \tau}{\sqrt[2]{LPM_{2p}(\tau)}} \quad (5)$$

Where, r_p^d is average returns of portfolio p and τ is minimum acceptable return. A higher Sortino ratio indicates low chances of suffering larger losses and vice-versa (Eling and Schuhmacher 2007). Many researchers and practitioners favor this ratio because it distinguishes between good and bad deviations. It does not penalize the portfolio with returns far away from their mean unlike Sharpe ratio.

3.2.2. Excess Return on Value-at-Risk (VaR)

Excess return on VaR is based on the assumption that risk factors are log-normally distributed (Kidd 2012). It is defined by Eling and Schuhmacher (2007) as a ratio of risk premium to VaR of the portfolio.

$$\text{Excess Return on VaR}_p = \frac{r_p^d - r_f}{VaR_p} \quad (6)$$

Where, r_p^d is average returns of portfolio p , r_f is risk free interest rate and $VaR_p = -(r_p^d + z_a \cdot \sigma_p)$ where z_a is a -quantile of the standard normal distribution and σ_p is standard deviation of portfolio return. This measure is criticized because VaR is not sub-additive, which means that by adding the risk of two assets VaR of the portfolio will not be greater than the sum of the risk of the two assets. These shortcomings led to the development of conditional VaR (CVaR), discussed below, as an alternative measure of risk (Kidd 2012).

3.2.3. Conditional Sharpe Ratio

CVaR was developed as an alternative measure to VaR because VaR does not consider the extent of losses when returns fall beyond the threshold amount. On the other hand, CVaR recognizes and quantifies the expected loss in the left tail of the distribution beyond VaR. It is given as,

$$CVaR_p = E[-r_{pt} | r_{pt} \leq -VaR_p] \quad (7)$$

The application of CVaR is appropriate when risk of a portfolio is narrowly defined, but as CVaR only considers the tail of the distribution, it is not suitable when a choice has to be made between two investments having the same CVaR with different shapes of distribution (Lleo 2009). CVaR is a risk measure used in conditional Sharpe ratio defined by Eling and Schuhmacher (2007) as follows,

$$\text{Conditional Sharpe ratio}_p = \frac{r_p^d - r_f}{CVaR_p} \quad (8)$$

Where, r_p^d is average returns of portfolio p , r_f is risk free rate of return and $CVaR_p$ is conditional VaR of portfolio p .

3.2.4. Modified Sharpe Ratio

Modified Sharpe ratio is used when portfolio returns do not follow normal distribution. In such cases VaR and CVaR are inefficient. It is a ratio of risk premium to modified Value-at-Risk⁷ (MVaR) of a portfolio of non-normal return distributions.

$$\text{Modified Sharpe ratio}_p = \frac{r_p^d - r_f}{MVaR_p} \quad (9)$$

⁷ See Favre and Galeano (2002) for a detailed explanation of MVaR.

Where, r_p^d is average returns of portfolio p , r_f is risk free rate of return and $MVaR_{1-\alpha} = \mu + Z_{CF,\alpha}\sigma$ where $1-\alpha$ is confidence level of MVaR, μ is potential drift rate of portfolio value, σ is standard deviation of portfolio returns and $Z_{CF,\alpha}$ is Cornish-Fisher approximation⁸ of the $\alpha\%$ quantile of the distribution. MVaR takes in to account higher moments of the return distribution, that is skewness and kurtosis, but there is a limitation on the confidence levels during its application. Cavenaile and Lejeune (2012) explain that MVaR should not be used with confidence levels below 95.84% so as to maintain consistency with investors' preferences for kurtosis. Thus, estimation of MVaR with 95% confidence level may give inconsistent results. As a result, we compute our results using 99% confidence level.

From the above discussion, we can see that several measures are proposed in literature to estimate mutual fund performance. We know that each performance measure views risk differently, which is why it is important to find a suitable measure. On the contrary, Eling and Schuhmacher (2007) argue that any performance measure can be used to evaluate portfolio performance since the choice of performance measure does not affect the rankings of funds. Thus, in order to put an end to this debate and clarify whether the choice of performance measure is significant or not, we continue our study by collecting and analyzing our mutual funds dataset for India, Singapore and Taiwan.

3.2. Data

For our empirical analysis, we have obtained daily prices of mutual funds and their indices for three markets, namely, India, Singapore and Taiwan. The period of our study is July 2009 to July 2012. The selected indices, Standard & Poor's Bombay Stock Exchange 100 (S&P BSE 100), Strait Times Index (STI) and Taiwan Stock Exchange Capitalization Weighted Stock Index (TAIEX), represent Broad Market Indices (BMIs) for respective markets. The mutual fund and index prices are denominated in local currencies in order to avoid problems associated with exchange rate fluctuations. Prices of mutual funds of Singapore and Taiwan and indices for all markets are obtained from Thomson Reuters Datastream. Indian mutual fund prices are obtained from Association of Mutual Funds in India (AMFI). Overnight interbank offered rates are considered as a proxy for risk-free rates. Mumbai Interbank Offered Rate (MIBOR) is sourced from the website of National Stock Exchange of India, Singapore Interbank Offered Rate (SIBOR) from the Monetary Authority of Singapore and Taipei Interbank Offered Rate (TAIBOR) from the Central Bank of the Republic of China (Taiwan). Additional variables such as large-cap and small-cap indices and value and growth indices for the three markets are obtained from MSCI Inc. Our sample data comprises of 1290 open-ended equity mutual funds - 673 of India, 281 of Singapore and 363 of Taiwan. Our dataset includes active and inactive funds and therefore, it does not suffer from survivorship bias. To determine whether the rankings of mutual funds is affected due to choice of a performance measure, we apply all the performance measures discussed in the previous sub-section and perform Spearman's rank correlation to the entire sample data.

Table 1: Summary Statistics of Daily Mutual Fund Returns

	INDIA	SINGAPORE	TAIWAN
Mean	0.000225	0.000044	-0.000015
Median	0.000586	0.000237	0.000350
Maximum	0.026520	0.012156	0.023800
Minimum	-0.030966	-0.017785	-0.037117
Std. Dev.	0.009169	0.003278	0.008114

⁸ Cornish-Fisher expansion is a by-product of Cornish and Fisher (1938). It is given as,

$$Z_{CF,a} = Z_a + \frac{1}{6}(Z_a^2 - 1)S + \frac{1}{24}(Z_a^3 - 3Z_a)K - \frac{1}{36}(2Z_a^3 - 5Z_a)S^2 \text{ where } Z_a \text{ is the } \alpha\% \text{ quantile of a standard normal distribution, } S \text{ is standardized skewness and } K \text{ is excess kurtosis.}$$

Table 1: Summary Statistics of Daily Mutual Fund Returns - continued

Skewness	-0.216481	-0.700319	-0.564784
Kurtosis	3.393070	6.776311	4.784566
Jarque-Bera	10.672030	530.604600	140.880600
Probability	0.004815	0.000000	0.000000
Observations	749	785	758

Note: Log returns of mutual fund prices are used for summary statistics.

Table 1 presents summary statistics of daily mutual funds returns of the three markets. Our dataset has approximately 750 observations for each market during the period 2009-2012. For each market, there is a minimum and maximum range of return values given in Table 1. Full sample results indicate that all markets have positive mean returns except Taiwan (-0.000015). India (0.000225) has a high average rate of return, and comparatively Singapore, which is a developed market⁹, does not offer higher rate of return. Standard deviation of India (0.009169) and Taiwan (0.008114) are the highest, and the lowest is for Singapore (0.003278), suggesting that the Indian and Taiwanese markets are highly volatile in comparison to Singapore. All markets demonstrate negative skewness implying that all markets have long left tails. Kurtosis value of India, Singapore and Taiwan is greater than 3, which indicates that their return distribution has high peaks and fat tails. Our summary statistics also presents the values of Jarque-Bera test to help us to determine if the returns follow a normal distribution. From the table, we can say that the assumption of normally distributed mutual fund returns must be rejected for all markets at 5% significance level.

We, then, test the stationarity of our dataset using the Augmented Dickey-Fuller (ADF) unit root test (Dickey and Fuller 1979). This unit root test is used to determine whether our dataset is stationary or non-stationary. The null hypothesis of a unit root is tested against the alternative hypothesis of no unit root. We depend on the Schwarz criteria to select the appropriate lag length since the ADF test values are sensitive to lag selection. Next, we employ the eight performance measures discussed in sub-section 3.1 to determine whether the funds rankings are affected due to the selection of a particular performance measure. To achieve our research objective, we attempt to find rank correlation between performance measures and assess the coefficient of correlation. We use Spearman's rank correlation to make our results comparable to Eling and Schuhmacher (2007). For performing rank correlation, we generate moving window of time using daily dataset of mutual fund returns for all three markets. The moving window of time is generated by taking a series of first 250 observations for each market. The window of time moves forward by leaving out the first 50 observations of the first series and taking in the next 250 observations and so on. This moving window of time is used to evaluate mutual funds using risk-adjusted and downside risk-adjusted performance measures. The next step involves ranking the funds on the basis of the resulting values and performing rank correlations between performance measures. We generate moving window of time using daily dataset of mutual fund returns for all three markets.

3.3. Empirical Results

This study uses the conventional unit root test to identify the stationarity of mutual fund returns using the ADF test. In case of all three markets, the null hypothesis of non-stationarity (unit root) is tested against the alternative hypothesis of stationarity. We apply unit root test on log prices at 1%, 5% and 10% significance levels. Table 2 presents unit root test results for a full sample of 1290 mutual funds. The ADF test statistic of India (-24.22791), Singapore (-20.95583) and Taiwan (-21.80612) are smaller than their critical values at 1%, 5% and 10% significance levels respectively. Therefore, we can reject the null hypothesis of non-stationarity and conclude that our dataset is stationary.

⁹ MSCI Developed Markets Index classifies Singapore as a developed market.

Table 2: Augmented Dickey Fuller (ADF) test for Daily Mutual Fund Returns

INDIA			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-24.228	0
Test critical values:	1% level	-3.4389	
	5% level	-2.8652	
	10% level	-2.5688	
SINGAPORE			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-20.956	0
Test critical values:	1% level	-3.4385	
	5% level	-2.865	
	10% level	-2.5687	
TAIWAN			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-21.806	0
Test critical values:	1% level	-3.4388	
	5% level	-2.8651	
	10% level	-2.5687	

*MacKinnon (1996) one-sided p-values.

In Table 3, we present Spearman's rank correlation coefficients of India, Singapore and Taiwan discussed in the previous chapter. In case of India, all performance measures show very high rank correlation with each other. The rank correlation coefficient between excess return on VaR and conditional Sharpe ratio (1.0000) is the highest. Rank correlation between Sharpe ratio and Treynor ratio (0.9909), excess return on VaR (0.9909), conditional Sharpe ratio (0.9909) and modified Sharpe ratio (0.9909) are also very high. The lowest rank correlation is between Sortino ratio and Jensen's Alpha (0.7909). On an average, rank correlation among all performance measures is high. Our results for rank correlation using Indian mutual fund returns are similar to those achieved by Eling and Schuhmacher (2007). In order to test the robustness of our results, we perform Spearman's rank correlation between performance measures using data set of Singapore and Taiwan's mutual fund market.

Table 3: Spearman's Rank Correlation on Risk-Adjusted and Downside Risk-Adjusted Performance Measures

INDIA								
Performance Measures	Jensen's Alpha	Fama-French three-factor	Sharpe Ratio	Treynor Ratio	Sortino Ratio	Excess Return on VaR	Conditional Sharpe Ratio	Modified Sharpe Ratio
Jensen's Alpha	1.0000	0.9636	0.9273	0.9364	0.7909	0.9182	0.9182	0.9364
Fama-French three-factor	0.9636	1.0000	0.8727	0.9000	0.8455	0.8818	0.8818	0.9000
Sharpe Ratio	0.9273	0.8727	1.0000	0.9909	0.8182	0.9909	0.9909	0.9909
Treynor Ratio	0.9364	0.9000	0.9909	1.0000	0.8545	0.9818	0.9818	1.0000
Sortino Ratio	0.7909	0.8455	0.8182	0.8545	1.0000	0.8545	0.8545	0.8545
Excess Return on VaR	0.9182	0.8818	0.9909	0.9818	0.8545	1.0000	1.0000	0.9818
Conditional Sharpe Ratio	0.9182	0.8818	0.9909	0.9818	0.8545	1.0000	1.0000	0.9818
Modified Sharpe Ratio	0.9364	0.9000	0.9909	1.0000	0.8545	0.9818	0.9818	1.0000

Note: 1) Minimum Acceptable Return (MAR) is assumed 10% per annum for the calculation of Sortino ratio. 2) VaR, CVaR and MVaR are estimated at 1% significance level.

Table 3: Spearman's Rank Correlation on Risk-Adjusted and Downside Risk-Adjusted Performance Measures - continued**SINGAPORE**

Performance Measures	Jensen's Alpha	Fama-French three-factor	Sharpe Ratio	Treynor Ratio	Sortino Ratio	Excess Return on VaR	Conditional Sharpe Ratio	Modified Sharpe Ratio
Jensen's Alpha	1.0000	0.9301	0.9790	0.9510	-0.1678	0.9790	0.9650	0.9650
Fama-French three-factor	0.9301	1.0000	0.8811	0.8392	-0.4126	0.9091	0.8741	0.8741
Sharpe Ratio	0.9790	0.8811	1.0000	0.9860	-0.1329	0.9580	0.9860	0.9860
Treynor Ratio	0.9510	0.8392	0.9860	1.0000	-0.1189	0.9371	0.9790	0.9790
Sortino Ratio	-0.1678	-0.4126	-0.1329	-0.1189	1.0000	-0.2238	-0.1818	-0.1818
Excess Return on VaR	0.9790	0.9091	0.9580	0.9371	-0.2238	1.0000	0.9720	0.9720
Conditional Sharpe Ratio	0.9650	0.8741	0.9860	0.9790	-0.1818	0.9720	1.0000	1.0000
Modified Sharpe Ratio	0.9650	0.8741	0.9860	0.9790	-0.1818	0.9720	1.0000	1.0000

Note: 1) Minimum Acceptable Return (MAR) is assumed 10% per annum for the calculation of Sortino ratio. 2) VaR, CVaR and MVaR are estimated at 1% significance level.

TAIWAN

Performance Measures	Jensen's Alpha	Fama-French three-factor	Sharpe Ratio	Treynor Ratio	Sortino Ratio	Excess Return on VaR	Conditional Sharpe Ratio	Modified Sharpe Ratio
Jensen's Alpha	1.0000	0.9720	1.0000	0.9930	0.7203	0.9510	0.9720	0.9720
Fama-French three-factor	0.9720	1.0000	0.9720	0.9790	0.6643	0.9371	0.9441	0.9441
Sharpe Ratio	1.0000	0.9720	1.0000	0.9930	0.7203	0.9510	0.9720	0.9720
Treynor Ratio	0.9930	0.9790	0.9930	1.0000	0.6993	0.9580	0.9790	0.9790
Sortino Ratio	0.7203	0.6643	0.7203	0.6993	1.0000	0.5664	0.6224	0.6224
Excess Return on VaR	0.9510	0.9371	0.9510	0.9580	0.5664	1.0000	0.9930	0.9930
Conditional Sharpe Ratio	0.9720	0.9441	0.9720	0.9790	0.6224	0.9930	1.0000	1.0000
Modified Sharpe Ratio	0.9720	0.9441	0.9720	0.9790	0.6224	0.9930	1.0000	1.0000

Note: 1) Minimum Acceptable Return (MAR) is assumed 10% per annum for the calculation of Sortino ratio. 2) VaR, CVaR and MVaR are estimated at 1% significance level.

The results differ when we use Singapore and Taiwan's mutual fund returns to measure rank correlations between performance measures. Singapore market displays highest rank correlation between conditional Sharpe ratio and modified Sharpe ratio (1.0000). The correlation of Sortino ratio with other performance measures is in contrast to the results of Sortino ratio obtained by Eling and Schuhmacher (2007). Our findings show a negative correlation between Sortino ratio and the remaining performance measures - Jensen's Alpha (-0.1678), Fama and French (1993) three-factor model (-0.4126), Sharpe ratio (-0.1329), Treynor ratio (-0.1189), excess return on VaR (-0.2238), conditional Sharpe ratio (-0.1818) and modified Sharpe ratio (-0.1818). For Taiwan, the highest rank correlation of 1.0000 is also obtained for VaR based measures, conditional Sharpe ratio and Modified Sharpe ratio. Sortino ratio displays positive low rank correlations with all performance measures - Jensen's Alpha (0.7203), Fama and French (1993) three-factor model (0.6643), Sharpe ratio (0.7203), Treynor ratio (0.6993), excess return on VaR (0.5664), conditional Sharpe ratio (0.6224) and modified Sharpe ratio (0.6224).

Based on our results, we find that not all performance measures are highly correlated with each other. In particular, Sortino ratio displays low rank correlations with other performance measures. We obtain different correlations between performance measures in different markets. As explained by Zakamouline (2010), high correlations may be a result of normal return distribution and the application of performance measures that compute risk in a similar manner. In our case, India deviates less from normality in comparison to Singapore and Taiwan, thus, the correlation between performance measures is higher for India than those of Singapore and Taiwan. Therefore we find that our results are not in agreement with Eling and Schuhmacher (2007) on the whole, and the reason for this disagreement may be due to the non-normality of our return distribution. We also find that in situations where performance measures compute risk in a similar manner, correlation is very high. For example, VaR

based measures such as excess return on VaR, conditional Sharpe ratio and modified Sharpe ratio have a common numerator, average excess return, which may be the reason for high correlation between them. We, thus, satisfy the observations of Zakamouline (2010) and our findings strengthen the argument that the choice of a performance measure does affect the ranking of mutual funds.

4. Conclusion

Mutual funds have emerged as an alternative investment choice for retail and institutional investors. They offer a wide variety of investment choices, flexibility and diversification benefits to investors. Investors' funds are allocated in different asset classes by investing in a mutual fund. The skills of fund managers, fund performance and fund rankings, therefore, play an important role during decision-making. Fund performance and rankings are usually made available to investors by agencies like Morning Star. Different performance measures are used by different sources to estimate past performance and rate them. Due to the availability of several measures to evaluate mutual fund performance, it is important to determine whether there is a significant impact on the rankings of funds by choosing a particular performance measure.

Our study contributes to the body of knowledge by providing empirical evidence on the impact of choice of performance measure on the rankings on mutual funds for three Asian markets. To the best of our knowledge, this is the first study to measure results for Asian markets of India, Singapore and Taiwan in this context. Another contribution of our study is the use of a good mix of risk-adjusted and downside risk-adjusted performance measures to arrive at our findings. This helps us to put an end to the increasing debate among academic researchers regarding the impact of choice of performance measure on mutual funds rankings.

We evaluate empirically the rank correlation of eight performance measures, for a sample of Asian mutual funds of India, Singapore, and Taiwan. The goal of our study was to investigate whether the use of performance measures affects the ranking of mutual funds. Our results indicate that when we use similar performance measures, rank correlations are very high. Specifically, our results show that VaR based performance measures have high correlation. This is in line with Eling and Schuhmacher (2007), but as we go further and use performance measures that are different from each other, rank correlations decrease. This is observed particularly in the case of Sortino ratio. The rank correlations for Sortino ratio are significantly lower for Singapore and Taiwan markets.

We find that our results vary from the outcome of Eling and Schuhmacher (2007) mainly due to: (a) use of performance measures that measure the risk-return relationship using a different approach. We use VaR based measures to show high rank correlation between measures that have a same numerator; and (b) use of a data set having non-normal return distribution. In our study, we reject the null hypothesis and establish that mutual fund returns of all markets are not normally distributed. When we compare the three markets, we see that India deviates less from normality while Singapore deviates the most. Accordingly, we observe that the correlation between performance measures for India is relatively higher than that of Singapore and Taiwan. This provides scope for further study to analyze and identify the factors that affect correlation patterns in performance measures across different markets.

From the above discussion, we establish that our findings are in line with Zakamouline (2010) and Ornelas, Silva Júnior and Fernandes (2012) who conclude that the choice of performance measures is significant and has an impact on the evaluation of mutual funds. Now that we have established that the choice of performance measure is important, the next question is which measure should an investor choose that gives a true picture of mutual fund performance? We observe that Eling and Schuhmacher (2007) suggests that since the choice of performance measure is not important, the use of any performance measure is justified. They believe that as Sharpe ratio is easily understood, it is adequate for performance evaluation. Although, their data set is largely normally distributed and the results of Sharpe ratio are only valid for normally distributed mutual fund returns, implying that Sharpe ratio is a good measure for analyzing hedge funds in general is not correct. Hedge funds are generally not

normally distributed and therefore, measuring fund performance using only Sharpe ratio is questionable. We have seen that the performance measures have developed from Markowitz (1959) portfolio theory, which assumes that all investors are risk-averse. In reality, most investors are risk-averse and therefore prime importance must be given to the risk-return profile of an investor while selecting an appropriate performance measure. We recommend that good performance measures are those that are highly correlated with measures that adjust for downward risk. In our study, risk-adjusted performance measures are highly correlated with VaR based downside risk-adjusted measures in all markets. Therefore, we conclude that a combination of risk-adjusted and downside risk-adjusted measure is meaningful for decision-making.

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